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Study Group:	**Working Party:**	**Intended type of document** (R-C-TD):	C
Source:	Nippon Telegraph and Telephone Corporation (NTT), Japan		
Title:	Proposal for a project to develop full reference media-layer objective metric for stereoscopic three-dimension video		

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Please don't change the structure of this table, just insert the necessary information.

1. Introduction

Stereoscopic three-dimensional (hereafter, 3D) broadcasting and delivery services over networks have become widespread, and their markets are expected to expand worldwide. 3D services for broadcasting have been launched worldwide, as indicated in Table 1. Many 3D Internet protocol television (IPTV) services have also started. The NTT group is now providing a 3D IPTV service.

It is important for service providers to provide a high-quality service. Therefore, quality planning and monitoring are important tasks for service providers. In IPTV services provided by the NTT group, operators at the head end watch 2D videos and check their quality. However, it is difficult for operators to continually watch 3D videos to monitor their quality. NTT recently received a request from a service provider of NTT the group to automatically monitor 3D video quality. Therefore, an objective quality assessment method (objective metric) that can be used for quantifying 3D video quality at the head end is necessary.

Though the video quality experts group (VQEG) has been studying subjective assessment methods, which are the fundamental method of quantifying video quality, in order to update ITU-R Recommendation BT.1438, an objective metric needs to be developed for 3D services Therefore, we propose to launch a project to develop an objective metric that will run in parallel with the project for the subjective assessment method.

2. Proposal

We propose to launch a new project to develop an objective metric for 3D services.

The objective metric for 3D services will be divided into four groups by scale (e.g., quality, depth, and comfort) and monitoring point (e.g., head end and end user), as shown in Table 2. Our focus is on developing an objective metric for monitoring 3D video quality at the head end as Phase I. A full reference (FR) media-layer objective metric is suitable in Phase I. The target applications of the objective metric for Phase I are as follows:

- Quality monitoring for 3D video service at head end.
- Quality measurement for 3D video encoding (e.g., for VoD and package media).

A current 3DTV project in VQEG involves investigating subjective assessment methods for 3D video quality and other QoE factors (e.g., depth and comfort). A subjective assessment method for 3D video quality has been established. Therefore, it is appropriate to focus on developing an objective metric for 3D video quality as Phase I. After establishing a subjective method for the other QoE factors, an objective metric for the other QoE factors should be investigated as Phase II.

Figure 1 shows diagrams of three types of possible processing chains for 3D services. These

processing chains are divided into three steps:
STEP A: uncompressed original 3D video is encoded,
STEP B: encoded 3D video is delivered to users on IP, broadcasting network, or Blu-ray disc, and
STEP C: encoded 3D video is decoded and displayed on a 3D monitor.

Generically, in a Blu-ray disc, frame-sequential (FS) 3D video is encoded by H.264/MVC. In broadcasting, side-by-side (SbS) 3D video is encoded by H.264/AVC. In a 3D simulcast, the left view of FS 3D video is encoded by MPEG-2 or H.264/AVC, and the right view of FS 3D video is encoded by H.264/AVC codec. Thus, quality degradation depends on the video format and codec. Therefore, an objective metric that can estimate such degradations is desired. Because 3D video is also affected by network performance (e.g., packet loss and delay) and packetization scheme (e.g., UDP, TCP), we need to take into account many types of quality degradation among video format, coding, and network performance. However, the packetization scheme for H.264/MVC and 3D simulcast has not been established. Therefore, we propose to focus on developing an FR media-layer objective metric for video format and coding as Phase I, which is used for 3D video quality monitoring at the head end. An objective metric for network performance, which is used for quality monitoring at the end user, should be investigated as Phase II after establishing a packetization scheme for H.264/MVC and simulcast.

To develop the metric, we also propose using part of the test plan and database for the 3D subjective assessment method for greater efficiency. However, to develop an FR media-layer objective metric for 3D video quality affected by video format and coding, we should focus on the following quality factors:

- Coding Schemes
  - H.264 (AVC high profile and main profile).
  - H.264 (MVC)
  - (optional) MPEG-2
- Video Encoding Modes
  - Constant-bit-rate encoding (CBR)
  - (optional) Variable-bit-rate encoding (VBR)
- Frame rates
  - 1080p SRC
    - 24 fps
    - (optional) 25, 29.97, 30 fps
  - 1080i SRC
    - 30 fps
    - (optional) 24, 25, 29.97 fps
- Down- and up-converting when side by side (SbS) is used
- Post-filtering

The target system requirements are as below:

- Display/Glasses type (e.g., frame-sequential/shutter, polarized/polarized)
- Video resolution (e.g., 1920×1080)

The supposed procedure is as follows.
STEP 1: Propose ToR and test plan (next meeting)
STEP 2: Propose CfP (first half of 2013)
STEP 3: Close CfP and conduct verification experiment (second half of 2013)
STEP 4: Analyze the results and prepare a report (2014)

Table 1 3D channels

Channel	Country(s)	Additional info.
HIGH TV 3D	Worldwide	Entertainment
WildEarth	Worldwide	Wildlife
n3D	United States	DirecTV only
Cinema 3D	United States	DirecTV only
3net	United States	DirecTV only
Sky 3D	United Kingdom and Republic of Ireland	Sky only
Foxtel 3D	Australia	Foxtel only
HD1	Belgium (and other European countries)	Free-to-air
Sky 3D	Germany and Austria	Sky Deutschland only
Anixe 3D	German-speaking countries	Free-to-air
3D-TV	Finland	
Sport 5 3D	Israel	
Sky 3D	Italy	Sky Italia only
MSG 3D	United States	Cablevision only
nShow 3D	Poland	ITI Group only
ESPN 3D	United States	
Xfinity 3D	United States	Comcast only
Penthouse 3D	Europe	
Canal+ 3D	France	Canal+ only
Canal+ 3D España	Spain	Canal+ only
NEXT Man 3D	Poland	
NEXT Lejdis 3D	Poland	
NEXT Young 3D	Poland	
Active 3D	India	Videocon d2h only
BS11	Japan	
RedeTV!	Brazil	
Viasat 3D	Sweden	Viasat only
Brava3D	Europe	Free-to-air
Teledünya 3D	Turkey	Teledünya only
Sky 3D	South Korea	SkyLife only
Sukachan 3D169	Japan	SKY PerfecTV! only
CANAL+ 3D	Poland	CYFRA+ only
TV Azteca 3D	Mexico	Free-to-air

Table 2 Group of objective metrics for 3D services

	Head end (Video format and coding)	End user (Network performance)
3D video quality	Phase I	Phase II
Other QoE factors (Depth, comfort, etc.)	Phase II	Phase II

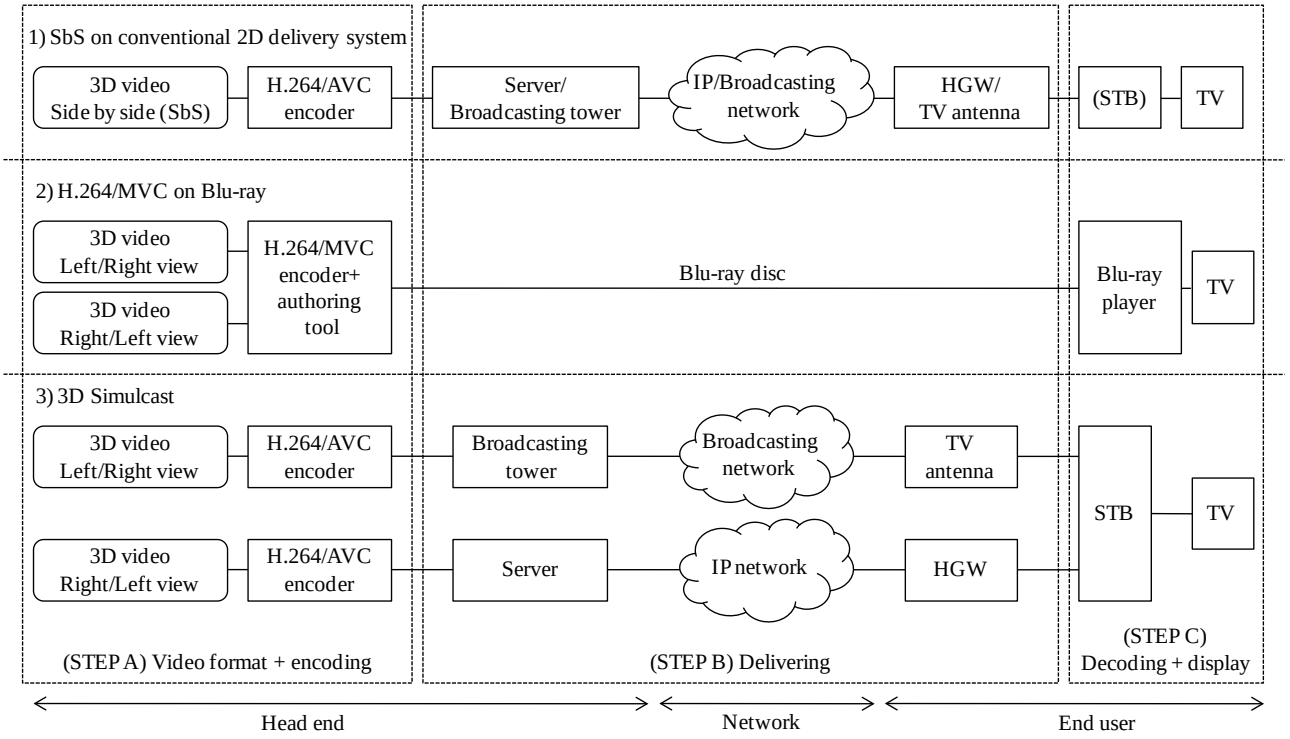

Figure 1 Processing chain diagrams for 3D services